Task 55 – Towards the Integration of Large SHC Systems into DHC Networks

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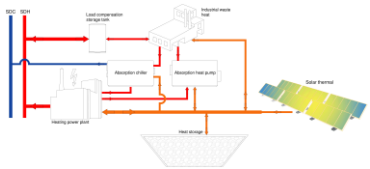

Task Overview

IEA SHC Task 55 elaborates on technical and economic requirements for the commercial market introduction of solar district heating and cooling systems in a broad range of countries. The Task activities aim to improve technological and market know-how, as well as to develop tools for the network integration of solar thermal systems and the implementation of other renewable energy technologies for maximum energy coverage. A key element is the direct cooperation of SDH experts with associations, companies, and institutions from the DHC community to bridge the gap between the research fields and organizations.

The Task's work is divided into four subtasks:

- Subtask A: Network Analyses and Integration (Austria)
- Subtask B: Components Testing, System Monitoring, and Quality Assurance (China)
- Subtask C: Design of the Solar Thermal System and of Hybrid Technologies (Denmark)
- Subtask D: Promotion and dissemination of SDH/SDC and hybrid technologies in new markets Scope (Germany)

Subtask A: Network Analyses and Integration (Lead Country: Austria)

The main research questions of Subtask A are how to integrate significant shares of ST, what the impact on other generation units is, how to solve the integration technically, and what measures are suitable to maximize the share of solar thermal applications.

The expected outcomes are: collection of best practice examples and case studies; energetic, ecologic and economic assessments of the overall solar DHC system; possible transformation strategies of DHC networks towards high shares of ST; lessons learnt on challenges and benefits of ST integration; optimized control strategies and hydraulic options for the integration of SHC systems into DHC networks.

Subtask B: Components Testing, System Monitoring, and Quality Assurance (Lead Country: China)

The main research objectives of Subtask B are to elaborate on methods for in in-situ collector tests, hybrid elements, and provide methods for simple thermal and energy performance proofs. Furthermore, it will provide data on automated monitoring and failure detection software for key components, and develop and describe control strategies for self-learning control systems.

Subtask C: Design of the Solar Thermal System and of Hybrid Technologies (Lead Country: Denmark)

Subtask C focuses on the simulation and design of solar thermal systems and components (storage, piping and others, e.g. heat pumps). The Subtask elaborates on characteristics of collector array units, large and seasonal storages, hydraulics, and heat pumps within system operations. Large scale collector fields will be simulated and compared to the measurements in Subtask B. If needed, the simulation tool will be corrected. Parameters of seasonal storages will be calculated and guidelines for the design and construction of different storage types updated. Hydraulics within systems are sensitive to a variety of parameters. These parameters will be optimized. Piping within large systems will be investigated as well and options for a modular conception and construction for very large systems.

Subtask D: Promotion and dissemination of SDH/SDC and hybrid technologies in new markets (Lead Country: Germany)

Subtask D elaborates economic aspects and the promotion of results from SHC Task 55. Large scale solar thermal systems require sophisticated financing models due to high initial investment costs. Different business models are already in place and facilitate the realization of large systems. The subtask will assist planers, architects, system designers and district heating providers in their efforts for the integration of DHC applications. Stakeholders face several economic challenges and risks and can benefit from the deliverables of this subtask.

Best practice examples will collect information on different system types already in operation. Moreover, the subtask will assist the other subtasks in the promotion and dissemination of their results.

Collaboration with Other IEA TCPs

The District Heating and Cooling including Combined Heat and Power Programme (IEA DHC) is officially collaborating with SHC Task 55 on a moderate level as defined by the IEA SHC.

Collaboration with Industry

Around 20 industry companies have been providing actively expertise to SHC Task 55. As most of them are not funded for the Task work their contribution is explicitly to highlight. All active experts are listed at the end of this report

Several SDH installations have been built due to cooperations, which started during the first Task meetings. For example, the installation in Tibet: link. As the SDH market is still a niche market, it´s very important, that strategic business cooperations have been established amongst the Task Experts during the Task life time.

Task Duration

The Task started in September 2016 and ended in December 2021. Due to the Covid situation the duration has been prolonged from September to December 2021.

Participating Countries

Austria, Canada, China, Denmark, Finland*, France, Germany, Italy, Spain, Sweden, United Kingdom
*Through IEA DHC
Observer: The Netherlands

Work Results During 2020

Subtask A: Network Analyses and Integration

- In synergy with D-D3 in Subtask D, the best-practice collection (with 17 installations) was uploaded on Task homepage
- Economic analysis of overall DHC network supply strategies, transition strategies, heat demand and energy price scenarios: The activities related to this deliverable consisted in organizing the available inputs to prepare the fact sheets. A-D2.1 and A-D2.3 are ongoing and expected by June 2020. Both fact sheets have been uploaded to the Task homepage.
- Techno-economic comparison of the collected best-practice examples: Fact sheet uploaded on Task homepage.
- A fact sheet about “The future of SDH in different European countries” was in finalization in the end of 2020 and will be available on the Task homepage within June 2021.
- SWOT analysis of solar thermal integration in district heating and cooling: Fact sheet uploaded on Task homepage.
- Feasibility analysis of hybrid technologies for DHC including ST: Fact sheet uploaded on Task homepage.
- Integration concepts of central ST systems in DHC: Fact sheet uploaded on Task homepage.
- Integration concepts of decentral solar thermal systems in DHC: Fact sheet uploaded on Task homepage.
- Large-scale thermal energy storage systems to increase the ST share in DHC: Fact sheet uploaded on Task homepage.
- Supervisory control of large-scale solar thermal systems: Fact sheet finalized and currently in review through experts and ExCos.
- Control of DHC networks and reduction of the operating temperatures in DH systems: Fact sheet finalized and currently in review through experts and ExCos.

Subtask B: Components Testing, System Monitoring, and Quality Assurance

- Improved in situ performance testing of line-concentrating solar collectors: Comprehensive uncertainty analysis for the selection of measurement instrumentation: Publication uploaded on the Task homepage (ELSEVIER paper)

- Solar energy - Collector fields - Check of performance: Fact sheet according to ISO 24194 was uploaded on the Task homepage.
- Control of large-scale solar thermal plants: Fact sheet finalized and currently in review through experts and ExCos.
- Automated monitoring solar thermal: Fact sheet uploaded on Task homepage.

Subtask C: Design of the Solar Thermal System and of Hybrid Technologies

- Long-term thermal performances of solar collector fields: Measured and calculated: Fact sheet uploaded on Task homepage.
- Solar radiation modelling on tilted surfaces based on global radiation: Fact sheet uploaded on Task homepage.
- Collector types for large collector fields - thermal performance: Fact sheet uploaded on Task homepage.
- CFD models of different collector types: Fact sheet uploaded on Task homepage.
- Seasonal pit heat storages – Guidelines for materials & construction: Fact sheet finalized and currently in review through experts and ExCos.
- Thermal and hydraulic investigation of large-scale solar collector field: Publication uploaded on the Task homepage (ELSEVIER paper)

Subtask D: Promotion and dissemination of SDH/SDC and hybrid technologies in new markets

- Business Models of Solar Thermal and Hybrid Technologies published on Task Homepage
- Investor Brochure “Solar heat for cities – The sustainable solution for district heating”: Investor Brochure uploaded; Translation in Turkish and Chinese are ongoing;
- Identification and preparation of Best Practice Examples: In synergy with subtask A, the best-practice collection (with 17 installations) was uploaded on Task homepage
- Evaluation of diverse global market developments for large scale SDH/SDC and country reports: Country reports of 7 countries (largest SDH installations)
- EnRSIM calculation tool for renewable district heating (technical and economic): Fact sheet uploaded on Task homepage.

Link to the fact sheets: https://task55.iea-shc.org/fact-sheets

Task 55 Follow Up Task

The draft concept paper of the follow up Task of Task 55 has been presented at the final Task 55 meeting and has earned a lot of positive feedback beside the notes, that there might be an overlapping with other TCPs Tasks/Annexes, what is in clearing by Task organizer Viktor Unterberger. At the 88th ExCo Meeting Mr. Unterberger has been confirmed as Task Organizer by the ExCos and has started the Task definition phase in December 2020. The first definition workshop will take place

Investor Brochure

Within Subtask D the investor brochure “Solar Heat for Cities” was developed and published in November 2019 by Bärbel Epp (SOLRICO). The brochure contains very useful info charts and general information about large scale SDH as well as several case studies of SDH installations in Denmark, China, Serbia, Austria, France, Latvia and Germany.

http://task55.iea-shc.org/publications
https://task55.iea-shc.org/

SDH markets are growing in Denmark, Germany, China and new markets are starting like in France, Italy, Poland, Spain etc. To increase the market share of SDH in new and existing markets, communication efforts are necessary. Therefore, one important activity in Subtask D was the preparation of an investor brochure with 20 pages in English language.

The target of this brochure is to raise awareness and interest about this technology and facilitate the entry of investors into SDH by answering their key questions. Successful case studies and testimonials that prove the key advantages of using SDH are a core part of the brochure. In order to meet the needs of the stakeholders, the seven sponsors as well as other experts work together in a task force to set up the content. The whole group of experts within Task 55 was involved in reviewing the drafts to ensure high quality content.

UK Training Workshop on Renewable Heat for Heat Networks

In December 2019 (presented to SHC ExCos in June 2020), Triple Point Heat Networks Investment Management, in collaboration with the IEA Solar Heating and Cooling TCP, hosted a workshop in the UK on Renewable Heat for Heat Networks. The workshop built upon the success of the March 2019 UK Solar Academy on Solar Heat Networks: Policy, Planning, Design and Performance. This second workshop was aimed at people either participating or seeking to participate in the HM Government Heat Network investment Project (HNIP) and provided attendees with a good grasp of what solar heat networks are, as well as supplying them with the resources they need to include solar in their heat network projects. IEA Solar Heating and Cooling TCP Task 55 (Towards the Integration of Large SHC Systems into District Heating and Cooling Networks) experts discussed the role which solar could play in decarbonising UK heat networks, providing examples from other projects across the world, discussing how these had been achieved, and providing evidence of the level of decarbonisation these had attained.

Four National Experts of the IEA Solar Heating and Cooling TCP Task 55 spoke about the role of solar in heat networks. These Experts were:

- Magdalena Kowalska from the renewable energy planning company, PlanEnergi, in Denmark;
- Christian Holter from the solar engineering company, SOLID, in Austria;
- Grant Feasey from the solar collector manufacturing company, AES Solar, in England
- Renaldi Renaldi from Oxford Martin School at the University of Oxford, in England.

The IEA Solar Heating and Cooling TCP speakers were also supported by experts from the IEA Heat Pumping Technologies TCP (Roger Hitchin), the IEA District Heating TCP (Dr Anton Ianakiev and Robin Wiltshire) and the Danish Embassy in the UK (Jacob Byskov Kristensen).

The workshop was fully booked, with the capacity of 120 attendees being reached within the first couple of weeks of launch. This clearly demonstrates the level of interest in solar as a component in heat networks and the demand for expert knowledge of their implementation.

Chair Election RHC Horizontal Working Group Renewable Districts

Heating & cooling and hot water preparation account for over half of the energy demand in buildings. Paired with an increasing urbanization rate, this demand defines one of the key challenges of the energy transition in Europe (and beyond): How to decarbonize heating & cooling in urban districts?
The members of the HWG (Horizontal Working Group) for renewable districts works in close collaboration with the other HWGs and more specifically on the following topics:

- New district heating systems (low temperature district heating)
- Refurbishment of existing district heating systems
- Urban sources for heating & cooling
- Individual heating solutions for urban use
- District cooling and individual cooling solutions for urban use
- Measures on the secondary side to support the roll-out of RES H&C solutions
- Toolboxes and stakeholder support
- Policy developments
- Economics and markets of and for RES DHC

The HWG will be tasked in 2021 with the development of a roadmap supporting the decarbonization of urban districts across Europe. On top a vision for 2050 is prepared and all results communicated towards policy-makers (e.g., European Commission) in the form of a briefing.

Sabine Putz as SOLID´s Head of R&D and Operating Agent of IEA SHC TASK 55 “Towards the Integration of Large SHC Systems into District Heating and Cooling (DHC) Networks” will lead this group as chair.
https://www.rhc-platform.org/meet-the-new-hwg-districts-chair-and-co-chair/

Work Planned For 2021

Task 55 ended officially in December 2020, 6 out of 26 publications/fact sheets are currently in review through experts or the ExCos.

Subtask A: Network Analyses and Integration

- The fact sheet about “The future of SDH in different European countries” was in finalization in the end of 2020 and will be available on the Task homepage in the beginning of 2021.
- Supervisory control of large-scale solar thermal systems: Fact sheet finalized and currently in review through experts and ExCos.
- Control of DHC networks and reduction of the operating temperatures in DH systems: Fact sheet finalized and currently in review through experts and ExCos.

Subtask B: Components Testing, System Monitoring, and Quality Assurance

- Control of large-scale solar thermal plants: Fact sheet finalized and currently in review through experts and ExCos.

Subtask C: Design of the Solar Thermal System and of Hybrid Technologies

- Seasonal pit heat storages – Guidelines for materials & construction: Fact sheet finalized and currently in review through experts and ExCos.

Subtask D: Promotion and dissemination of SDH/SDC and hybrid technologies in new markets

- Translation of the Investor Brochure into Turkish and Chinese (this was no deliverables – not mandatory)

Dissemination Activities In 2020

Reports, Published Books

Author / Editor	*Title*	*Bibliographic Reference*
Sabine Putz	7th Task 55 semi-annual Status Report	
Sabine Putz	8th Task 55 semi-annual Status Report	
Sabine Putz	Task 55 Annual Report 2020	
Sabine Putz	Task 55 Highlights 2020 Report	
Richard Hall (ExCo UK)	Report about Solar Academy Training in December 2019	
Bärbel Epp, Task 55	Task 55 Investor Brochure	http://files.iea-shc.org/public/mrj/d-d2-investor-brochure.pdf

Journal Articles, Conference Papers, etc.

Author(s)	Title	Publication / Conference	Bibliographic Reference
Unterberger, V., Muschick, D., Loidl, A., Poms, U. R., Gölles, M., & Horn, M. (2020).	Model-based control of hydraulic heat distribution systems — Theory and application	Control Engineering Practice, 101, [104464].	https://doi.org/10.1016/j.conengprac.2020.104464
Kaisermayer, V., Muschick, D., Gölles, M., & Horn, M. (2020).	Progressive Hedging for Stochastic Energy Management Systems: The Mixed-Integer Linear Case. Energy Systems	Control Engineering Practice, Elsevier	https://doi.org/10.1016/j.conengprac.2020.104464
Moser, A. G. C., Muschick, D., Gölles, M., Nageler, P. J., Schranzhofer, H., Mach, T., Hofer, A. (2020).	A MILP-based modular energy management system for urban multi-energy systems: Performance and sensitivity analysis	Applied Energy, 261, [114342].	https://doi.org/10.1016/j.apenergy.2019.114342
Ochs, Fabian; Dahash, Abdulrahman; Tosatto, Alice and Bianchi Janetti, Michele (2020).	Techno-economic planning and construction of cost-effective large-scale hot water thermal energy storage for renewable district heating systems	Renewable Energy Elsevier	Renewable Energy, 150, 1165-1177. DOI: 10.1016/j.renene.2019.11.017.
Dahash, Abdulrahman; Ochs, Fabian; Tosatto, Alice and Streicher, Wolfgang. (2020).	Toward efficient numerical modeling and analysis of large-scale thermal energy storage for renewable district heating	Applied Energy	Applied Energy, 279, 115840. DOI: 10.1016/j.apenergy.2020.115840.
Paolo Leoni, Roman Geyer, Ralf-Roman Schmidt	Developing innovative business models for reducing return temperatures in district heating systems: Approach and first results	Energy	Vol. 195, 2020, 116963 https://doi.org/10.1016/j.energy.2020.116963
Tschopp, D., Tian, Z., Berberich, M., Fan, J., Perers, B., Furbo, S., 2020:	A review and comparative study of Denmark, China, Germany and Austria.	Applied Energy, 270, 114997,	doi.org/10.1016/j.apenergy.2020.114997
Tschopp, D., Jensen, A. R., Dragsted, J., Ohnewein, P., Furbo, S.,	Measurement and modeling of diffuse irradiance masking on tilted planes for solar engineering applications	under review at Applied Energies	
Zlabinger, S., Unterberger, V., Gölles, M., Horn, M., Wernhart, M., & Rieberer, R. (2020).	Development and experimental validation of a linear state-space model absorption heat pumping systems for model-based control strategies	In T. Meyer (Ed.), ISHPC 2021 proceedings – online pre-conference 2020 (pp. 191 -195). Technische Universität Berlin	https://doi.org/10.14279/depositonce-10430.2

Tschopp, Daniel	Review of In situ Test Methods for Solar Thermal Installations		
SOLITES	SDH newsletter; News about SDH market, promotion of the brochure “Solar Heat for Cities”	www.solar-district-heating.eu; April 2020	https://www.solar-district-heating.eu/solar-heat-for-cities-iea-brochure-and-infographics/
Putz, S. Murphy, P.	SHC Newsletter contributions	June and October 2020	
Epp, B.	1 GW - Danish SDH market reaches new milestone	Solarthermalworld.org	https://www.solarthermalworld.org/news/danish-sdh-market-reaches-new-milestone
Newsletter Fernwärme/Kälte	Newsletter Fernwärme/Kälte		
Epp, B.	Success Factors in top SDH countries	June 2020	
Epp, B.	Improved design for giga-size pit heat storage GBP 320 million for low-carbon heat networks	October 2020	

Conferences, Workshops, Seminars

Conference / Workshop / Seminar Name	Activity & Presenter	Date & Location	# of Attendees	If Task Hosted: Organized with, # participants
Solarthermalworld Interview during SWC in Chile	Putz, S.; Interview at SWC 2019, Interview Keynote Speech Solar District Heating IEA SHC Task 55 - Towards the Integration of Large SHC Systems into DHC Networks	Chile, November 2019	400	
6th International Conference on Smart Energy Systems	Paolo Leoni, Aurelien Bres, Ilaria Marini, Alessandro Capretti; Lowering the operating temperatures in old-generation district heating systems: first results from the TEMPO demonstration project in Brescia (Italy)	6 - 7 October 2020, online	n.a.	
In T. Meyer (Ed.), ISHPC 2021 proceedings – online pre-conference 2020 (pp. 191 -195).	Zlabinger, S., Unterberger, V., Gölles, M., Horn, M., Wernhart, M., & Rieberer, R. (2020).; Development and experimental validation of a linear state-space model absorption	August 2020, Online	n.a.	

Technische Universität Berlin	heat pumping systems for model-based control strategies https://doi.org/10.14279/depositonce-10430.2			
13th International Conference on Solar Energy for Buildings and Industry (EuroSun 2020)	Putz, S. ; Results of IEA SHC TASK 55 “Towards the Integration of Large SHC Systems into DHC Networks	September 1 – 3, 2020	around 300 – via Zoom	
13th International Conference on Solar Energy for Buildings and Industry (EuroSun 2020)	Dahash, Abdulrahman; Ochs, Fabian and Tosatto, Alice: Advances in modeling and evaluation of large-scale hot water tanks and pits in renewable-based district heating	September 1 – 3, 2020	around 300 – via Zoom	
Technology Transfer Workshop TASK 55	Finishing event after the final TASK 55 meeting	October 15, 2020	72, Zoom	72

Dissemination Activities Planned For 2021/2022

- Abstract submitted by Putz, S. for 17th International Symposium on DHC in Nottingham, September 2021
- Abstract submitted by Putz, S. for Euroheat & Power Congress, May 2021
- Plan to submit an abstract for the ISEC, 2nd International Sustainable Energy Conference, Graz, October 2022
- Technology position paper June 2021

Task Meetings in 2020

The final expert meeting in in April 2020 was postponed to October 2020 due the COVIS situation.

Meeting	Date	Location	# of Participants (# of Countries)
Final Experts Meeting	13 – 14 October 2020	Zoom	51 (11)
Technology Transfer Workshop	15 October 2020	Zoom	72 (11)

SHC Task 55 Participants

Country	Name	Institution / Company	Role
Australia	Ken Guthrie	Former SHC Chair	National Expert
Austria	Christian Engel	Thermaflex Int Holding	National Expert
Austria	Christian Fink	AEE – Institute for Sustainable Technologies	National Expert
Austria	Christian Holter	SOLID	National Expert
Austria	Daniel Tschopp	AEE – Institute for Sustainable Technologies	National Expert
Austria	Daniel Muschick	BIOENERGY 2020+ GmbH	National Expert
Austria	Fabian Ochs	University of Innsbruck	National Expert
Austria	Georg Sima	MGR GEORG SIMA E.U.	National Expert
Austria	Ingo Leusbrock	AEE INTEC	National Expert
Austria	Moritz Schubert	SOLID	National Expert
Austria	Markus Gölles	Bioenergy 2020+ GmbH	National Expert
Austria	Peter Luidolt	SOLID	National Expert
Austria	Philip Ohnewein	AEE INTEC	National Expert
Austria	Patrick Reiter	SOLID	National Expert
Austria	Paolo Leoni	AIT	National Expert
Austria	Ralf-Roman Schmidt	AIT/Austrian Institute of Technology	Subtask A Leader
Austria	Viktor Unterberger	Bioenergy 2020+ GmbH	National Expert
Austria	Werner Doll	SOLID	National Expert
Austrian	Christian Holter	SOLID	National Expert
Austrian	Sabine Putz	SOLID	OA
Canada	James Bererton	Naked Energy	National Expert
Canada	Lucio Mesquita	CanmetENERGY	National Expert
China	Jianhua Fan	Technical University of Denmark	National Expert
China	Youjin Xu	Tongji university	National Expert
China	Aaron Feng Gao	Arcon-Sunmark Large-scale Solar Systems Integration Co., Ltd,	National Expert
China	Liu MU	Vicot Solar Technology Co., Ltd	National Expert
China	Qingtai Jiao	Jiangsu Sunrain Solar Energy Co., Ltd	Subtask B Leader

China	Kaichun Li	Jiangsu Sunrain Solar Energy Co., Ltd	National Expert
China	Shai Li	Jiangsu Sunrain Solar Energy Co., Ltd	National Expert
China	Zheng Wei	Yazaki Energy System Corporation	National Expert
Denmark	Lars Munkoe	Purix	National Expert
Denmark	Andreas Zourellis	Aalborg CSP	National Expert
Denmark	Bengt Perers	Technical University of Denmark	National Expert
Denmark	Christian Kok Nielsen	PlanEnergi	National Expert
Denmark	Jan Birk	Arcon Sunmark	National Expert
Denmark	Jakob Jensen	Heliac	National Expert
Denmark	Jes Donneborg	Aalborg CSP	National Expert
Denmark	Jan Erik Nilsen	PlanEnergi	Subtask C Leader
Denmark	Jianhua Fan	Technical University of Denmark	National Expert
Denmark	Junpeng Huang	Technical University of Denmark	National Expert
Denmark	Povl Frich	Danish Energy Agency	National Expert
Denmark	Simon Furbo	Technical University of Denmark	National Expert
Denmark	Zhiyong Tian	Technical University of Denmark	National Expert
Finland	Kaj Pischow	Savo-Solar Oy	National Expert
Finland	Morten Hofmeister	Savo-Solar Oy	National Expert
France	Alexis Gonnelle	New Heat Directeur technique / CTO	National Expert
France	Cedric Paulus	CEA/INES	National Expert
France	Nicolas Lamaison	CEA/INES	National Expert
France	Paul Kaaijk	Ademe	National Expert
France	Pierre Delmas	New Heat Directeur technique / CTO	National Expert
Germany	Axel Gottschalk	Bremerhaven University of Applied Sciences	National Expert
Germany	Magdalena Berberich	Solites	Subtask D Leader
Germany	Dominik Bestenlehner	ITW/TZS University of Stuttgart	National Expert
Germany	Detlev Seidler	SOLID	National Expert
Germany	Dan Bauer	DLR	National Expert
Germany	Dominik Bestenlehner	IGTE University of Stuttgart	National Expert
Germany	Bärbel Epp	Solrico	National Expert
Germany	Andrej Jentsch	Operating Agent DHC	National Expert
Germany	Karin Rühling	TU Dresden	National Expert
Germany	Korbinian Kramer	Fraunhofer ISE	National Expert
Germany	Roman Marx	ITW University of Stuttgart	National Expert
Germany	Nirendra Lal Shrestha	Technische Universität Chemnitz	National Expert
Germany	Norbert Rohde	KBB Kollektorbau Gmbh	National Expert
Germany	Stefan Mehnert	ISE	National Expert
Germany	Sven Fahr	Fraunhofer ISE	National Expert
Germany	Thorsten Urbanek	TU Chemnitz	National Expert
Italy	Luca Degiorgis	Politecnico di Torino	National Expert
Italy	Marco Calderoni	Polimi	National Expert
Italy	Roberto Fedrizzi	Eurac Research	National Expert
Italy	Marco Scarpellino	TVP Solar	National Expert
Netherlands	Luuk Beurskens, L.W.M.	ECN-TNO	National Expert
Netherlands	Ruud Vandenbosch	Ecovat	National Expert
Poland	Armen Jaworski	Cim-Mes	National Expert

Spain	Ana Lazaro	University of Zaragozza	National Expert
Spain	Andoni Diazdemendibil	Tecnalia	National Expert
Spain	Carol Pascual	Tecnalia	National Expert
Spain	Javier Mazo	University of Zaragoza	National Expert
Spain	Miguel Lozano	University of Zaragozza	National Expert
Spain	Patricio Aguirre Múgica	Tecnalia	National Expert
Spain	Luis M. Serra	University of Zaragoza	National Expert
Sweden	Joakim Byström	Absolicon Solar Collector AB	National Expert
Sweden	Josefine Nilsson	Absolicon Solar Collector AB	National Expert
Sweden	Gunnar Lennermo	Energianalys AB	National expert
Sweden	Klaus Lorenz	Dalarna University	National Expert
Sweden	Peter Kjellgren	Absolicon Solar Collector AB	National Expert
Switzerland	Vittorio Palmieri	TVP Solar	National Expert
The Netherlands	Luuk Beurkens	ECN-TNO	National Expert
United Kingdom	Eamon Clarke	Kingspan Environmental Ltd.	National Expert
United Kingdom	Finbarr McCarthy	Kingspan Environmental Ltd.	National Expert
United Kingdom	Martin Crane	Carbon Alternatives Ltd	National Expert
United Kingdom	Richard Hall	Energy Transition	ExCo, Vice Chair
United Kingdom	Joshua King	AES Solar	National Expert